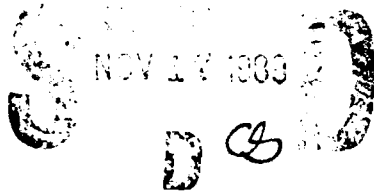


AD-A214 444

***Copolymers for Drag Reduction  
in Marine Propulsion:***

***New Molecular Structures  
with Enhanced Effectiveness***

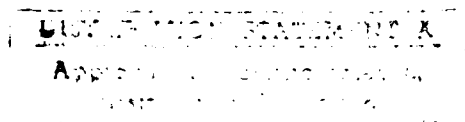
**Quarterly Report for the Period  
June 1, 1989 - August 31, 1989**



**PRINCIPAL INVESTIGATORS**

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## Syntheses

The first phase of synthetic research has begun with initial emphasis placed on preparation of copolymers of acrylamide with diacetone acrylamide (AM-DAAM) and ampholytic terpolymers of acrylamide and sodium 2-acrylamido-2-methylpropanedimethylammonium chloride with sodium-2-acrylamido-2-methylpropane sulfonate (ADASAM series) or with sodium-3-acrylamido-3-methylbutanoate (ADABAM series).

## Molecular Characterization

Construction of the proposed preparative scale size exclusion chromatography system is well underway. The system will be able to separate high molecular weight water-soluble polymers for subsequent drag reduction studies.

## Friction Reduction Measurements

Construction of the proposed tube flow apparatus for measurement of drag reduction is completed. Testing of polyethylene oxide and polyacrylamide standards is in progress.

## Technical Manuscripts Submitted

"Water-Soluble Polymers. XXXIII. Ampholytic Terpolymers of Sodium 2-Acrylamido-2-Methylpropanesulfonate with 2-Acrylamido-2-Methylpropane-Dimethylammonium Chloride and Acrylamide: Synthesis and Aqueous Solution Behavior," C. L. McCormick and C. B. Johnson, 1988, submitted to *Polymer*, May 1989.

"Water-Soluble Polymers. XXXIV. Ampholytic Terpolymers of Sodium 2-Acrylamido-2-Methylpropanesulfonate with 2-Acrylamido-2-Methylpropane-Dimethylammonium Chloride and Acrylamide: Synthesis and Absorbency Behavior," C. L. McCormick and C. B. Johnson, 1988, submitted to *J. Macromol. Sci., Chem.*, May 1989.

## Preprints Submitted

"Copolymers of Acrylamide with (2-Acrylamido-2-Methylpropyl)Trimethyl Ammonium Chloride," C. L. McCormick, J. R. Danford, J. K. Newman, and L. C. Salazar, National ACS Meeting, Miami, FL (1989).

"Volume Fraction Normalization Technique for the Study of Drag Reduction Efficiency," C. L. McCormick, P. S. Mumick and S. E. Morgan, National ACS Meeting, Miami, FL (1989).

"Structural Design of Water-Soluble Copolymers for Specific Solution Properties and Behavior," C. L. McCormick, National ACS Meeting, Miami, FL (1989).

"Synthesis of Pyrene-Labeled High Molecular Weight Acrylamide Copolymers," C. L. McCormick and S. A. Ezzell, National ACS Meeting, Miami, FL (1989).

"Copolymers of Acrylamide and a Novel Sulphobetaine Amphoteric Monomer," C. L. McCormick and L. C. Salazar, National ACS Meeting, Miami, FL (1989).

"Synthesis and Characterization of Hydrophobically Modified Acrylamide-Based Polyelectrolytes," C. L. McCormick, J. C. Middleton and D. Cummins, National ACS Meeting, Miami, FL (1989).

"Photophysical and Rheological Studies of the Aqueous Solution Properties of a Naphthalene Containing Polyacid," C. L. McCormick, M. D. Clark and T. A. Schott, National ACS Meeting, Miami, FL (1989).

"Size Exclusion Chromatography of High Molecular Weight Water-Soluble Polymers," R. D. Hester and A. M. Safieddine, National ACS Meeting, Miami, FL (1989).

"Determination of Molecular Weight Distributions of Large Water Soluble Macromolecules," R. D. Hester and M. J. Mettelle, National ACS Meeting, Miami, FL (1989).

"The Effects of Macromolecular Structure and Solvent Ordering on Drag Reduction Efficiency," C. L. McCormick, R. D. Hester, S. E. Morgan, and P. S. Mumick, First Pacific Polymer Conference, Maui, HI, December 12-15, 1989.

### Technical Presentations

"Solution Behavior of Sulfobetaine/Acrylamide Copolymers," C. L. McCormick and L. C. Salazar, *Abstracts MAS*, 34, 51 (1989).

"Investigations into the Micellar Polymerization of Hydrophobically Modified Acrylamide Copolymers," C. L. McCormick and J. C. Middleton, *Abstracts MAS*, 34, 52 (1989).

"Micellar Polymerization of Hydrophobically Modified Acrylamide Based Polyelectrolytes for Enhanced Oil Recovery," C. L. McCormick, D. S. Cummins and J. C. Middleton, *Abstracts MAS*, 34, 53 (1989).

"Solution Behavior of 2-Acrylamido-2-Methyl-1(2-Naphthylsulfonamido)Propane Containing Copolymers," C. L. McCormick, T. A. Schott and M. D. Clark, *Abstracts MAS*, 34, 53 (1989).

"Synthesis and Characterization of Photoactive Water-Soluble Polymers," C. L. McCormick, L. J. Bartel and S. A. Ezzell, *Abstracts MAS*, 34, 55 (1989).

"Photophysical Studies of Pyrene-Labelled Polyampholytes," C. L. McCormick and M. D. Clark, *Abstracts MAS*, 34, 55 (1989).

"Synthesis and Characterization of Hydrophobically Modified Water-Soluble Polymers," C. L. McCormick and J. R. Danford, *Abstracts MAS*, 34, 55 (1989).

"Synthesis and Characterization of Water-Soluble Acrylamide Copolymers for the Study of Drag Reduction," C. L. McCormick and P. S. Mumick, *Abstracts MAS*, 34, 55 (1989).

"Synthesis and Characterization of Polymeric Controlled-Release Herbicide Systems," C. L. McCormick and J. K. Newman, *Abstracts MAS*, 34, 55 (1989).

"The Effects of Polymer Molecular Weight on Drag Reduction," A. M. Safieddine and R. D. Hester, *Abstracts MAS*, 34, 51 (1989).

"Molecular Weight Distributions of Water-Soluble Polymers from Dynamic Light Scattering Data," M. J. Mettelle and R. D. Hester, *Abstracts MAS*, 34, 52 (1989).

"Copolymers of Acrylamide and a Novel Sulphobetaine Amphoteric Monomer," C. L. McCormick and L. C. Salazar, Southeastern Graduate Polymer Conference, Georgia Institute of Technology, Atlanta, GA, April 17-19, 1989.

"Determination of Excimer Fluorescence for 4-(1-Naphthylacetamido) Butanoic Acid," C. L. McCormick, T. A. Schott and M. D. Clark, Symposium for Innovation in Measurement Science (SIMS 89), Geneva, NY, August 6-11, 1989.

### **Technical Manuscripts Published**

"Synthetically Structured Water-Soluble Copolymers: Associations by Hydrophobic or Ionic Mechanisms," C. L. McCormick and C. B. Johnson, chapter in *Polymers in Aqueous Media*, J. E. Glass, ed., ACS Books, Advances in Chemistry Series No. 223, 437-454 (1989).

"Water Soluble Polymers," C. L. McCormick, J. Bock, and D. N. Schulz, *Encyclopedia of Polymer Science and Engineering*, Vol. 17, John Wiley and Sons, New York, 730-784 (1989).